



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUL 16 2002

OFFICE OF
AIR AND RADIATION

Ms. Janet Newton
President
The EMR Network
P.O. Box 221
Marshfield, VT 05658

Dear Ms. Newton:

This is in reply to your letter of January 31, 2002, to the Environmental Protection Agency (EPA) Administrator Whitman, in which you express your concerns about the adequacy of the Federal Communications Commission's (FCC) radiofrequency (RF) radiation exposure guidelines and nonthermal effects of radiofrequency radiation. Another issue that you raise in your letter is the FCC's claim that EPA shares responsibility for recommending RF radiation protection guidelines to the FCC. I hope that my reply will clarify EPA's position with regard to these concerns. I believe that it is correct to say that there is uncertainty about whether or not current guidelines adequately treat nonthermal, prolonged exposures (exposures that may continue on an intermittent basis for many years). The explanation that follows is basically a summary of statements that have been made in other EPA documents and correspondence.

The guidelines currently used by the FCC were adopted by the FCC in 1996. The guidelines were recommended by EPA, with certain reservations, in a letter to Thomas P. Stanley, Chief Engineer, Office of Engineering and Technology, Federal Communications Commission, November 9, 1993, in response to the FCC's request for comments on their Notice of Proposed Rulemaking (NPRM), *Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation* (enclosed).

The FCC's current exposure guidelines, as well as those of the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission on Non-ionizing Radiation Protection, are thermally based, and do not apply to chronic, nonthermal exposure situations. They are believed to protect against injury that may be caused by acute exposures that result in tissue heating or electric shock and burn. The hazard level (for frequencies generally at or greater than 3 MHz) is based on a specific absorption dose-rate, SAR, associated with an effect

that results from an increase in body temperature. The FCC's exposure guideline is considered protective of effects arising from a thermal mechanism but not from all possible mechanisms. Therefore, the generalization by many that the guidelines protect human beings from harm by any or all mechanisms is not justified.

These guidelines are based on findings of an adverse effect level of 4 watts per kilogram (W/kg) body weight. This SAR was observed in laboratory research involving acute exposures that elevated the body temperature of animals, including nonhuman primates. The exposure guidelines did not consider information that addresses nonthermal, prolonged exposures, i.e., from research showing effects with implications for possible adversity in situations involving chronic/prolonged, low-level (nonthermal) exposures. Relatively few chronic, low-level exposure studies of laboratory animals and epidemiological studies of human populations have been reported and the majority of these studies do not show obvious adverse health effects. However, there are reports that suggest that potentially adverse health effects, such as cancer, may occur. Since EPA's comments were submitted to the FCC in 1993, the number of studies reporting effects associated with both acute and chronic low-level exposure to RF radiation has increased.

While there is general, although not unanimous, agreement that the database on low-level, long-term exposures is not sufficient to provide a basis for standards development, some contemporary guidelines state explicitly that their adverse-effect level is based on an increase in body temperature and do not claim that the exposure limits protect against both thermal and nonthermal effects. The FCC does not claim that their exposure guidelines provide protection for exposures to which the 4 W/kg SAR basis does not apply, i.e., exposures below the 4 W/kg threshold level that are chronic/prolonged and nonthermal. However, exposures that comply with the FCC's guidelines generally have been represented as "safe" by many of the RF system operators and service providers who must comply with them, even though there is uncertainty about possible risk from nonthermal, intermittent exposures that may continue for years.

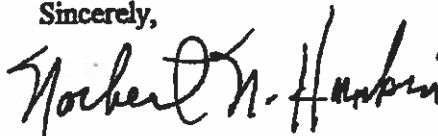
The 4 W/kg SAR, a whole-body average, time-average dose-rate, is used to derive dose-rate and exposure limits for situations involving RF radiation exposure of a person's entire body from a relatively remote radiating source. Most people's greatest exposures result from the use of personal communications devices that expose the head. In summary, the current exposure guidelines used by the FCC are based on the effects resulting from whole-body heating, not exposure of and effect on critical organs including the brain and the eyes. In addition, the maximum permitted local SAR limit of 1.6 W/kg for critical organs of the body is related directly to the permitted whole body average SAR (0.08 W/kg), with no explanation given other than to limit heating.

I also have enclosed a letter written in June of 1999 to Mr. Richard Tell, Chair, IEEE SCC28 (SC4) Risk Assessment Work Group, in which the members of the Radiofrequency Interagency Work Group (RFIAWG) identified certain issues that they had determined needed to be addressed in order to provide a strong and credible rationale to support RF exposure guidelines.

Federal health and safety agencies have not yet developed policies concerning possible risk from long-term, nonthermal exposures. When developing exposure standards for other physical agents such as toxic substances, health risk uncertainties, with emphasis given to sensitive populations, are often considered. Incorporating information on exposure scenarios involving repeated short duration/nonthermal exposures that may continue over very long periods of time (years), with an exposed population that includes children, the elderly, and people with various debilitating physical and medical conditions, could be beneficial in delineating appropriate protective exposure guidelines.

I appreciate the opportunity to be of service and trust that the information provided is helpful. If you have further questions, my phone number is (202) 564-9235 and e-mail address is hankin.norbert@epa.gov.

Sincerely,



Norbert Hankin
Center for Science and Risk Assessment
Radiation Protection Division

Enclosures:

- 1) letter to Thomas P. Stanley, Chief Engineer, Office of Engineering and Technology, Federal Communications Commission, November 9, 1993, in response to the FCC's request for comments on their Notice of Proposed Rulemaking (NPRM), Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation
- 2) June 1999 letter to Mr. Richard Tell, Chair, IEEE SCC28 (SC4) Risk Assessment Work Group from the Radiofrequency Radiation Interagency Work Group



INTERNATIONAL PRECAUTIONARY ACTIONS by Governments, Authorities and Schools.

France: New National Legislation and the National Agency for Health, Food and Environmental Safety Report.

2015 Law passed:

- **WiFi Banned in Nursery Schools:** WIFI and Wireless devices will be banned in "the spaces dedicated to home, to rest and activities of children under 3 years".
- **WiFi on "OFF" as Default to Minimize Exposures in Schools:** In elementary schools, WIFI routers should be turned off when not in use.
- **Schools Will be Informed:** The school board should be informed when new tech equipment is being installed.
- **Cell Tower Emission Compliance Will Be Verified:** A decree will define the limits of emission of equipments for electronic communications or transmission to which the public is exposed. These values can be verified by accredited organizations and results will be made accessible to the public through a National Radiofrequency Agency.
- **Citizens Will Have Access to Environmental/Cell Tower Radiation Measurements** Near homes: Every resident may get access to the results of measurements for their living space.
- **Cell Antennae Maps For the Country:** A description and map of the places with atypical (higher than the limits) places will be conducted at regular intervals with follow up of the actions being taken to limit the exposure. A map of all antennas will be produced for each town.
- **Continued Evaluation of Health Effects:** The National Radiofrequency Agency will be in charge of surveillance and vigilance, evaluating potential risks and setting up scientific research, including information on health effects.
- **SAR Radiation Labeling Mandated:** The SAR of cell phones must be clearly indicated on the package.
- **Information on Reducing Exposures Mandatory:** Information on ways to reduce exposure will be detailed in the contents of the cell phone package. .
- **WiFi Hotspots will be Labeled:** Places where WIFI is provided should be clearly marked with a pictogram.
- **Advertisements Must Recommend Devices That Reduce Radiation Exposure to the Brain:** Advertising for cell phones should clearly indicate the recommendation of hand free kits for protection of the head of the user and it will be included in the package. Advertising for cell phone not accompanied by such a kit is forbidden. Companies in violation will be fined 75,000 Euros.
- **Children Must Be Provided Protections:** At the request of the buyer, equipment reducing cell phone radiation exposures to the head for children less than 14 years should be provided.
- **The Public Will Be Informed:** Within a year, a policy of information on awareness and information on a responsible and reasonable use of cell phones and other apparatus emitting radiofrequencies will be set up.
- **Electrohyper-sensitivity Report To Be Submitted:** Within a year, a report on electrohyper sensitivity must be given to the Parliament.

- 2011 French Cell Phone Statute: Merchants must display SAR Radiation levels for different phone models, all phones must be sold with a headset, cell phone ads aimed at children younger than 14 are banned and phones made for children under 6 are banned.
- 2013 ANSES Report recommends hands free phones, SAR labeling, and "limiting the population's exposure to radiofrequencies... especially for children and intensive users, and controlling the overall exposure that results from relay antennas."
- The French National Library along with other libraries in Paris, and a number of universities have removed all Wi-Fi networks.
- Herouville-Saint-Clair has removed all Wi-Fi equipment installed in municipalities.

Belgium: Federal Public Health Regulations on March 2013 due to Health Concerns for Children.

- **Phones designed for children under 7 years old are prohibited from sale.**
- **Total Advertising Ban on cell phones aimed at children younger than 14.**
- Mandatory Radiation SAR levels must be available for consumers at point of sale.
- Warning label on phones: **"Think about your health – use your mobile phone moderately, make your calls wearing an earpiece and choose a set with a lower SAR value."**
- Recommendations include use of hands-free methods to keep the phone away from the body such as text messaging and not making calls when the signal is weak, such as in elevator/vehicle.
- Ghent Municipality: Wireless internet is banned from spaces that cater to children between 0 and three: preschools and daycares to reduce exposure to microwave radiation.
- Belgium has set a RF limit of 3V/m (at 900MHz) for cell antennas in certain locations such as indoors, schools, and playgrounds.

Spain: The Parliament of Navarra voted to urge removal of WIFI in schools and to apply the precautionary principle in relation to exposure limits to electromagnetic fields whose boundaries have become "obsolete".

- The Parliament voted to adopt a resolution which calls to implement the Parliamentary Assembly of the Council of Europe resolution 1815 of 2011, which recommends to "review the scientific basis for the standards of exposure to electromagnetic fields" and "set thresholds for levels of preventive long-term exposure in all indoor areas not exceeding 0.6 volts per meter".

Canada: Health Canada offers "Practical Advice" on reducing exposure to wireless radiation.

Recommendations: 1. Limit the length of cell phone calls, 2. Replace cell phone calls with text, use "hands-free" devices and 3. Encourage children under the age of 18 to limit their cell phone usage

- 2015: National Bill C-648 Introduced into the House Of Commons, "An Act Respecting the Prevention of Potential Health Risks From Radiofrequency Electromagnetic Radiation" would require manufacturers of all wireless devices to place specific health warning labels clearly on packaging, or face daily penalties /fines and/or imprisonment.
- Canadian Parliament Standing Committee on Health of the House of Commons issued a report "Radio Frequency Electromagnetic Radiation and the Health of Canadians" on June, 2015 after holding public hearings regarding Health Canada's Safety Code 6 recommended limits. They made 12 recommendations including an awareness campaign on reducing exposures, improved information collecting and policy measures regarding the marketing of radiation emitting devices to children under the age of 14, "in order to ensure they are aware of the health risks and how they can be avoided."

Australia: In 2013 the Australian Radiation Protection and Nuclear Safety Agency issued Fact Sheet 14: titled *How to Reduce exposure from mobile phones and other wireless devices*.

- Reduce the risk from WiFi devices by "keeping them at a distance, for example placing the wireless router

away from where people spend time", and "reducing the amount of time you use them".

- "ARPANSA recommends that parents encourage their children to limit their exposure."

Italy:

- On June 10, 2015, the State Parliament of South Tyrol voted to allow the application of the precautionary principle mandating the state government to:
 - 1. To replace existing wireless networks whenever possible with networks that emit less radiation at schools, preschools, hospitals, nursing homes, and other public facilities.
 - 2. Establish a working group whose mandate it is to assess these new technologies and their exposure levels. With regard to wireless communication technologies, mobile Internet access, and public health, the working group shall clarify which technologies emit less radiation and provide sustainable technology options and
 - 3. To start an education and awareness campaign that informs about possible health risks, especially regarding the unborn, infants, children, and adolescents and that develops guidelines for a safer use of cell phones, smartphones, and Wi-Fi ...Discussion at the Plenary Session, 10 June 2015 (in German) //Official Files, Resolutions (in German) //Previous Hearing at the Parliament of South Tyrol, 29 April 2015 (in German)
- The Italian Supreme Court ruled a man's brain tumor was caused by his cell phone use in 2012. The National Institute for Workmen's Compensation must compensate a worker with head tumor due to cell use.

Finland: The Radiation and Nuclear Safety Authority issued recommendations for children which include: favoring text messages, parents limiting duration and amount of calls, the use of hands free devices, avoiding calls in a low reception area and keeping the phone away from the body.

- "With children, we have reason to be especially careful, because there is not enough research on children's mobile phone use", according to STUK research director Sisko Salomaa.

Israel: The Israeli Ministry Of Education has issued guidelines limiting WiFi and cell phone use in schools.

- Preschool through 2nd grade have banned the use of wireless networks. In third and fourth grade class internet is restricted to 3 hours per week.
- A hard wired direct cable connection is required if the teacher has a computer in the class. Magnetic fields below 4mG are being reduced.
- The Israeli Supreme Court ordered the Israeli government to reply on ceasing Wifi installations
- In third and fourth grade class internet is restricted to 3 hours per week.
- The Education Ministry has instructed all schools to perform radiation tests.
- Israel's Minister of Health Rabi Litzman stated that he supports a ban on Wi-Fi in schools.
- A hard wired direct cable connection is required if the teacher has a computer in the class.
- Government created the Webpage National Information Ctr for Non-Ionizing Radiation
- Read the official ISRAEL 2015 RF Safety Report

Switzerland: The Governing Council of Thurgau Canton 2008 "The Governing Council recommends for schools to forgo the use of wireless networks when the structural makeup of a given school building allows for a wired network."

Germany: The German Federal Ministry for Radiation Protection states, "supplementary precautionary measures such as wired cable alternatives are to be preferred to the WLAN system."

- Bavaria: The State Ministry of Education and Cultural Affairs: "For precautionary reasons the Federal Office for Radiation Protection recommends for schools that if a wireless network is used to place its components in

suitable locations and to prefer the use of wired network solutions whenever possible." In 2007 Parliament recommendation to all schools to *not* install wireless LAN networks.

- Frankfurt: "In Frankfurt's schools there will be no wireless networks in the short or mid term. The Local Education Authority did not wish to conduct a "large scale human experiment," said Michael Damian, spokesperson of the Head of the School Department Jutta Ebeling.

Austria:

- "The official advice of the Public Health Department of the Salzburg Region is not to use WLAN and DECT in Schools or Kindergartens." -Gerd Oberfeld, MD.
- The Austrian Medical Society has issued cell phone safety guidelines stating that cell phones should be used for as short of a time as possible and that children under 16 should not use cell phones at all. They also state that wireless LAN leads to high microwave exposure.

India: 2012 The Ministry of Communications and Information Technology issued EMF guidelines with new Exposure Limits lowered to 1/10 of the ICNIRP level, SAR labeling on phones.

- Official guidelines for cell phone use include: Headsets, Speakerphones, limiting cell use, increasing distance from devices, and choosing landlines.
- 2013: Supreme Court of India upheld the High Court of the State of Rajasthan decision to remove all cell towers from the vicinity of schools, hospitals and playgrounds because of radiation "hazardous to life."
- The Ministry of Communications and Information Technology has an EMF webpage
- Zilla Parishad orders removal of all cellphone towers near schools citing exposure to "harmful radiation".

Russia: The Russian Federation advises that those under the age of 18 should not use a mobile phone at all, recommends low- emission phones; and requires the following: on-device labelling notifying users that it is a source of RF-EMF, user guide information advising that "it is a source of harmful RF-EMF exposure" and the inclusion of courses in schools regarding mobile phones use and RF-EMF exposure issues. The Russian National Committee on Non-Ionizing Radiation Protection has repeatedly warned about electromagnetic radiation impacts on children and recommended WiFi not be used in schools.

- "Thus, for the first time in the human history, children using mobile telecommunications along with the adult population are included into the health risk group due to the RF EMF exposure."
- "In children, the amount of so-called stem cells is larger than in adults and the stem cells were shown to be the most sensitive to RF EMF exposure."
- "It is reasonable to set limits on mobile telecommunications use by children and adolescents, including ban on all types of advertisement of mobile telecommunications for children."
- Decision of Russian National Committee on Non-Ionizing Radiation Protection 2008, "Children and Mobile Phones: The Health of the Following Generations is in Danger"

European Environment Agency: "All reasonable measures to be taken to reduce exposures to electromagnetic fields, especially radiofrequencies from mobile phones and particularly the exposures to children and young adults. Current exposure limits to be reconsidered."

United Kingdom: The UK National Health Service offers specific Recommendations for children and cell phones as "children are thought to be at higher risk of health implications".

- "Children should only use mobile phones for essential purposes and keep all calls short. "
- For the public they have "recommendations to help lower any potential long-term risks" which include keeping calls short, keep phone away from the body on standby mode, only use it when the reception is strong and use a phone with an external antenna.

**Resolution 1815: In 2011 The Parliamentary Assembly of the Council of Europe issued
*The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment.***

A call to European governments to "take all reasonable measures" to reduce exposure to electromagnetic fields "particularly the exposure to children and young people who seem to be most at risk from head tumours." The Resolution calls for member states to:

- Implement "information campaigns about the risk of biological effects on the environment and human health, especially targeting children and young people of reproductive age. "
- "Reconsider the scientific basis for the present standards on exposure to electromagnetic fields set by the International Commission on Non-Ionising Radiation Protection, which have serious limitations, and apply ALARA principles, covering both thermal effects and the athermic or biological effects of electromagnetic emissions or radiation."

"For children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by schoolchildren on school premises."

United States: Legislation has been introduced at the state and national level. Some Communities have issued proclamations, resolutions and started initiatives to inform the public of wireless health issues.

- **NEW 2015 NEW Massachusetts** proposed S1222: An Act creating a special commission to study the health impacts of electromagnetic fields and Bill H2007: An Act relative to a special commission to study electric and magnetic fields. Bills Still in Process as of August, 2015. Watch a view of the statehouse briefing on RF here.
- **NEW 2015 Nassau County** will have a proposed **Wireless Router Labeling Act** that would place visible warning signs in all county buildings and facilities where a wireless router is located.. Please read recent coverage of the initiative here.
- **2014 California, Berkeley:** May 12, 2015 Berkeley Adopted the Cell Phone "Right to Know" Ordinance on a Unanimous Vote. Berkeley is the first city in the nation to require cell phone retailers to provide those who purchase a new phone an informational fact sheet which informs buyers to read the user manual to learn the cell phone's minimum separation distance from the body. The text states:
"The City of Berkeley requires that you be provided the following notice:
To assure safety, the Federal Government requires that cell phones meet radio frequency (RF) exposure guidelines. If you carry or use your phone in a pants or shirt pocket or tucked into a bra when the phone is ON and connected to a wireless network, you may exceed the federal guidelines for exposure to RF radiation. This potential risk is greater for children.
Refer to the instructions in your phone or user manual for information about how to use your phone safely." Full text here.
- **2014 New York: Wireless Router Labeling in all Suffolk Public buildings:** 12/2014 The Suffolk County Legislature passed legislation to require all county buildings to post notices that wireless routers are in use such as, "Notice: Wireless technology in use." The resolution, sponsored by Legis. William Spencer (a physician), warns that every wireless device emits radio frequency radiation or microwave radiation. It notes that studies "that have looked at the effects of low-level RFR radiation on human cells and DNA have been inconclusive."
- **2014 Maryland, Greenbelt:** The Greenbelt Maryland City Council voted unanimously on November 24, 2014

1. Alert citizens about the fine print warnings and possible health risks of cell phones and wireless devices By sharing the Environmental Health Trusts 10 Steps to Safe Tech and Doctors Advice on Cell Phones Brochure in City health fairs and city centers.
 2. To send the FCC Chairman a letter urging the adoption of "radiation standards that will protect human health and safety."
 3. To oppose cell towers on school grounds and write a letter to the local school board and County Executive.
- **2012 Wyoming: Jackson Hole issued a Proclamation of Cell Phone Awareness** which cites concern over long term health effects as well as the increased risk that the radiation poses to children.
 - **2012 Florida: Pembroke Pines, passed Resolution 3362** expressing the City's "Urgent Concerns" about Wireless Radiation and Health and which encourages citizens to read their manuals and presents information on how to reduce exposure by using a headset or speakerphone. Jimmy Gonzalez, an attorney who had developed brain cancer after heavy cell use, initially petitioned the Commission. Watch the Video of his powerful testimony here.
 - **2010 California, San Francisco: Cell Phone Radiation (How to Reduce Exposures) Webpage** launched. Answers on how to reduce exposures to cell phone radiation. The City developed a poster, factsheets and display stickers with public health information.
 - **2010 California: Burlingame California City Council** voted to include cell phone safety guidelines in their Healthy Living in Burlingame initiative (WHO classification and consumer precautions).
 - **2010 Maine, Portland :**Mayor Mavodenes, Jr. declared October "Cell Phone Awareness Month"

US Proposed Legislation

- **2012 National Law The Cell Phone Right to Know Act H.R. 6358** was introduced receiving strong support from many organizations including the American Academy of Pediatrics. (AAP Letter here.) This legislation called for labels on mobile devices at point of sale, a comprehensive national research program to study whether exposure to wireless devices causes adverse biological effects directed by NIEHS and the EPA and exposure level regulation.
- **2014 The Maine LD 1013 "The Wireless Information Act"** passed the State Senate and House but then failed to pass the second vote. The Bill requires manufacturer's information on radio-frequency exposure be visible on the outside of the cell phone's product packaging.
- **2014 Hawaii Senate Bill SB 2571** was introduced calling for a warning label encouraging consumers to follow the enclosed product safety guidelines to reduce exposure to radiation that may be hazardous to their health.
- **The San Francisco Cell Phone Right to Know Ordinance** was signed in 2011 requiring cell phone retailers to distribute an educational sheet created by the San Francisco Department of Environment that explains radiofrequency emissions from cell phones and how consumers can minimize their exposure. The CTIA sued the city and settled with the City to block implementation of the Ordinance in exchange for a waiver of attorneys' fees. The City Cell Phone Radiation Webpage remains online.
- **SB 932 California, HM 32, New Mexico, HB 1408 Pennsylvania, and SB 679 Oregon.**

Schools Worldwide Removing the WiFi

2015: Ashland Public Schools, Mass (USA): "Best Practices" to turn the WiFi off when not in use, Download Slides

2015: St. Cajetan School, Belgium: Wired Internet installed and wireless removed.

2015: Washington Waldorf School, Maryland, USA: Removed Wi-Fi Routers from Buildings, Ethernet installed.

2014: DearCroft Montessori: Hardwired internet to younger grades, limited Wi-Fi Router exposure to older grades.

2014: Portland Waldorf School, Portland Oregon, USA, WiFi removed.

2014: Meeting House Montessori, Braintree Massachusetts, USA, WiFi replaced with ethernet.

2014: Ghent, Finland, Wi-fi banned from pre-schools and day care.

2014: UPPER Sturt Primary School, Australia "No WIFI" LOW EMF Policy

2014: The St. Augustine School in Italy turned off Wifi and goes back to Wires.

2013 Winlaw Elementary School, B.C. Canada turned off WiFi.

2013 Te Horo Primary School New Zealand Replaced WIFI with cable-based internet.

2013 Kootenay Lakes District School Board BC (One school without Wi-Fi)

2013 Blaise-Cendrars High School, Switzerland. Teachers vote to remove WiFi.

2012 Kivioja primary school in Ylivieska Finland bans phones and minimizes Wireless.

2012: Halton Waldorf, in Burlington Vermont: Remaining free of Wireless Radiation

2011 City of Lakes Waldorf School, WiFi taken out. Minneapolis, Minnesota USA

2011 Aurora School in Ontario removed Wifi and replaced with hardwired.

2011 North Cariboo Christian School in Quesnel, B.C., removed Wi-fi .

2011 Pretty River Academy in Ontario no WiFi.

2011 Wayside Academy, Peterborough, Ontario no Wi Fi.

2010 Surrey, BC Roots and Wings Montessori removed Wi-Fi.

2010 Ontario St. Vincent Euphrasia elementary school: Parents voted to turn off Wi-Fi.

2009 HEROUVILLE-SAINT-CLAIR wi-fi networks removed.

Teacher Unions and Parent Teacher Organizations

2014 United Federation of Teachers (teachers, nurses and professionals working in New York City).

- New Wireless Radiation Webpage states, "Wireless radiation is emitted by the myriad of wireless devices we encounter every day. It was once thought to be relatively harmless. However, we now know that wireless radiation can cause non-thermal biological effects as well, including damage to cells and DNA, even at low levels.
- Resources posted on their site include Dr. Moskowitz' Reducing Your Exposure to Wireless Radiation and the BabySafe Project brochure What You Need to Know About Wireless Radiation and Your Baby. "Taking certain precautions around wireless radiation is appropriate for our most vulnerable populations, including pregnant women."

2014 New York State Teacher's Union NYSUT: A federation of more than 1,200 local unions.

- NYSUT hosted a Webinar: Risks of wireless technologies and protecting children and staff in schools.

2013 Canadian Teacher Federation's Brief (200,000 elementary and secondary school teachers)

- "CTF is concerned about the lack of definitive research regarding the adverse health effects of Wi-Fi.
- "We propose a prudent approach to the use of Wi-Fi, especially where children are present."
- "We recommend an education program regarding the relative safety of Wi-Fi exposure and that appropriate resources be developed to educate the public regarding ways to avoid potential exposure risks of Wi-Fi

access points and devices."

- "Pedagogical needs could be met in schools with an approach that limits exposure to Wi-Fi."

2013 United Teachers of Los Angeles, representing 40,000 teachers and staff

- Resolution passed: "I move that UTLA will abide by current National NEA Policy for Environmentally Safe Schools which states that all employees and stakeholders should be informed when there are changes in their exposure to environmental hazards including electromagnetic radiation and that all stakeholders and the public should be notified of any actual and potential hazards."

2013 Elementary Teacher's Federation of Ontario - over 76,000 teachers

- Label the location Of Wi-Fi access points.
- Develop a hazard control program related to wireless microwave radiation through JHSC.

2012 The Ontario English Catholic Teachers Association (45,000 Ontario teachers)

- Recommends a wired infrastructure as WIFI "may present a potential Health and Safety risk or hazard in the workplace...The safety of this technology has not thoroughly been researched and therefore the precautionary principle and prudent avoidance of exposure should be practiced."

"The National Education Association believes that all educational facilities must have healthy indoor air quality, be smoke-free, be safe from environmental and chemical hazards, and be safe from hazardous electromagnetic fields." **Section C-19 of the NEA 2013-2014 Resolutions**

2013 BC Teachers Federation adopted Wireless Resolutions and Proposed Resolutions

- "The BCTF supports members who are suffering from Electromagnetic Hypersensitivity by ensuring their medical needs are accommodated in the workplace."
- Proposed Resolutions "the World Health Organization's classification of radiofrequency/electromagnetic fields emitted by wireless devices as a 2B possible cancer risk to humans; that the BCTF ensures all teachers have the right to work in a safe environment, including the right to work in a Wi-Fi/ wireless-free environment."
- Recommendation to the Ministry of Education that school boards "begin immediate installation of on/off switches for Wi-Fi routers in schools, thereby reducing microwave radiation exposure and reducing health risks to members, and/or provide safer Ethernet cables or fibre optics".

2013 The BC Confederation of Parent Advisory Councils (BCCPAC) of 821 Advisory Councils representing over 500,000 parents in British Columbia passed two resolutions.

- Resolution 17 "calls on each Board of Education to have one public school at each education level that is free of Wi-Fi, cordless phones and cell phones. This school will only be equipped with wired computers and wired telephones for personal, educational and administrative purposes."
- Resolution 18 calls on Boards of Education to "cease to install Wi-Fi and other wireless networks in schools where other networking technology is feasible." passed with a clear majority.

2010 UK VOICE ;The Union for Education Professionals- 20,000 members

- "Voice has advocated that new Wi-Fi systems should not be installed in schools, that existing systems should be turned off when not required and that schools should consider whether they really need to use Wi-Fi, which was developed to facilitate Internet access on the move rather than to be used as a convenient alternative to cables in dedicated IT facilities."

2010 Greater Victoria Teachers' Association

- Wi-Fi free zones should be available.
- On/Off routers recommended and record any adverse Wi-Fi health effects.
- Minimal or non-use within elementary schools.

2008 Lucerne Elementary Secondary Arrow Lakes District SD 10 New Denver BC, Canada Opts for "No WIFI

DOCTORS AND SCIENTISTS APPEAL FOR STRICTER WIRELESS TECHNOLOGY REGULATION

<u>Vienna Resolution 1998</u> <u>Salzburg Resolution 2000</u> <u>Stewart Report, UK 2000</u> <u>Declaration of Alcalá 2002</u> <u>Catania Resolution 2002</u> <u>Freiburger Appeal 2002</u> <u>Bamberger Appeal 2004</u> <u>Maintaler Appeal 2004</u> <u>International Association of Fire Fighters Resolution on Cell Towers 2004</u> <u>Coburger Appeal 2005</u> <u>Oberammergau Appeal 2005</u> <u>Haibacher Appeal 2005</u> <u>Pfarrkirchener Appeal 2005</u> <u>Freienbacher Appeal 2005</u> <u>Lichtenfelser Appeal 2005</u>	<u>Hofer Appeal 2005</u> <u>Helsinki Appeal 2005</u> <u>Parish Kirchner Appeal 2005</u> <u>Saarlander Appeal 2005</u> <u>Stockacher Appeal 2005</u> <u>Vancouver School Resolution 2005</u> <u>Benevento Resolution 2006</u> <u>Allgäuer Appeal 2006</u> <u>WiMax Appeal 2006</u> <u>Schlüchterner appeal 2006</u> <u>Brussels Appeal 2007</u> <u>Venice Resolution 2008</u> <u>Porto Alegre Resolution 2009</u> <u>European Parliament EMF Resolution 2009</u> <u>Dutch Appeal 2009</u> <u>Int'l Appeal of Würzburg 2010</u> <u>Copenhagen Resolution 2010</u> <u>Seletun Consensus Statement 2010</u>	<u>Russian National Committee on Non-Ionizing Radiation Protection 2011</u> <u>Potenza Picena Resolution 2011</u> <u>World Health Organization 2011</u> <u>Austrian Medical Association 2012</u> <u>Resolution on Electromagnetic Health 2012</u> <u>British Doctor Initiative 2013</u> <u>BabySafe Project: Joint Statement on Pregnancy and Wireless Radiation 2014</u> <u>Canadian Doctors Declaration to Health Canada 2014</u> <u>Scientific Declaration to Health Canada (International Doctors) 2014</u> <u>International Scientists Appeal to U.N. to Protect Humans and Wildlife from Electromagnetic Fields and Wireless Technology 2015</u> Over 200 Scientists
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Scientists warn of potential serious health effects of 5G

September 13, 2017

We the undersigned, more than 180 scientists and doctors from 35 countries, recommend a moratorium on the roll-out of the fifth generation, 5G, for telecommunication until potential hazards for human health and the environment have been fully investigated by scientists independent from industry. 5G will substantially increase exposure to radiofrequency electromagnetic fields (RF-EMF) on top of the 2G, 3G, 4G, Wi-Fi, etc. for telecommunications already in place. RF-EMF has been proven to be harmful for humans and the environment.

5G leads to massive increase of mandatory exposure to wireless radiation

5G technology is effective only over short distance. It is poorly transmitted through solid material. Many new antennas will be required and full-scale implementation will result in antennas every 10 to 12 houses in urban areas, thus massively increasing mandatory exposure.

With "the ever more extensive use of wireless technologies," nobody can avoid to be exposed. Because on top of the increased number of 5G-transmitters (even within housing, shops and in hospitals) according to estimates, "10 to 20 billion connections" (to refrigerators, washing machines, surveillance cameras, self-driving cars and buses, etc.) will be parts of the Internet of Things. All these together can cause a substantial increase in the total, long term RF-EMF exposure to all EU citizens.

Harmful effects of RF-EMF exposure are already proven

More than 230 scientists from 41 countries have expressed their "serious concerns" regarding the ubiquitous and increasing exposure to EMF generated by electric and wireless devices already before the additional 5G roll-out. They refer to the fact that "numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines". Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plants and animals.

After the scientists' appeal was written in 2015 additional research has convincingly confirmed serious health risks from RF-EMF fields from wireless technology. The world's largest study (25 million US dollar) National Toxicology Program (NTP), shows statistically significant increase in the incidence of *brain and heart cancer* in animals exposed to EMF below the ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines followed by most countries. These results support results in human epidemiological studies on RF radiation and brain tumour risk. A large number of peer-reviewed scientific reports demonstrate harm to human health from EMFs.

The International Agency for Research on Cancer (IARC), the cancer agency of the World Health Organization (WHO), in 2011 concluded that EMFs of frequencies 30 KHz – 300 GHz are possibly carcinogenic to humans (Group 2B). However, new studies like the NTP study mentioned above and several epidemiological investigations including the latest studies on mobile phone use and brain cancer risks confirm that RF-EMF radiation is carcinogenic to humans.

The EUROPA EM-EMF Guideline 2016 states that "there is strong evidence that *long-term exposure to certain EMFs is a risk factor for diseases* such as certain cancers, Alzheimer's disease, and male infertility...Common EHS (electromagnetic hypersensitivity) symptoms include headaches, concentration difficulties, sleep problems, depression, lack of energy, fatigue, and flu-like symptoms."

An increasing part of the European population is affected by ill health symptoms that have for many years been linked to exposure to EMF and wireless radiation in the scientific literature. The International Scientific Declaration on EHS & multiple chemical sensitivity (MCS), Brussels 2015, declares that: "In view of our present scientific knowledge, we thereby stress all national and international bodies and institutions...to recognize EHS and MCS as true medical conditions which acting as sentinel diseases may create a *major public health concern in years to come worldwide* i.e. in all the countries implementing unrestricted use of electromagnetic field-based wireless technologies and marketed chemical substances... *Inaction is a cost to society* and is not an option anymore... we unanimously acknowledge this serious hazard to public health...that major primary *prevention measures are adopted and prioritized, to face this worldwide pan-epidemic in perspective.*"

Precautions

The Precautionary Principle (UNESCO) was adopted by EU 2005: "When human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm."

Resolution 1815 (Council of Europe, 2011): "Take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies from mobile phones, and particularly the exposure to children and young people who seem to be most at risk from head tumours...Assembly strongly recommends that the ALARA (as low as reasonably achievable) principle is applied, covering both the so-called thermal effects and the athermic [non-thermal] or biological effects of electromagnetic emissions or radiation" and to "improve risk-assessment standards and quality".

The Nuremberg code (1949) applies to all experiments on humans, thus including the roll-out of 5G with new, higher RF-EMF exposure. All such experiments: "should be based on previous knowledge (e.g., an expectation derived from animal experiments) that justifies the experiment. No experiment should be conducted, where there is an a priori reason to believe that death or disabling injury will occur; except, perhaps, in those experiments where the experimental physicians also serve as subjects." (Nuremberg code pts 3-5). Already published scientific studies show that there is "a priori reason to believe" in real health hazards.

The European Environment Agency (EEA) is warning for "Radiation risk from everyday devices" in spite of the radiation being below the WHO/ICNIRP standards. EEA also concludes: "There are many examples of the failure to use the precautionary principle in the past, which have *resulted in serious and often irreversible damage to health and environments*...harmful exposures can be widespread before there is both 'convincing' evidence of harm from long-term exposures, and biological understanding [mechanism] of how that harm is caused."

"Safety guidelines" protect industry – not health

The current ICNIRP "safety guidelines" are obsolete. All proofs of harm mentioned above arise although the radiation is below the ICNIRP "safety guidelines". Therefore new safety standards are necessary. The reason for the misleading guidelines is that "conflict of interest of ICNIRP members due to their *relationships with telecommunications or electric companies* undermine the impartiality that should govern the regulation of Public Exposure Standards for non-ionizing radiation...To evaluate cancer risks it is necessary to include scientists with competence in medicine, especially oncology."

The current ICNIRP/WHO guidelines for EMF are based on the obsolete hypothesis that "The critical effect of RF-EMF exposure relevant to human health and safety is heating of exposed tissue." However, scientists have proven that many different kinds of *illnesses and harms are caused without heating ("nonthermal effect")* at radiation levels well below ICNIRP guidelines.

We urge the EU:

- 1) **To take all reasonable measures to halt the 5G RF-EMF expansion** until independent scientists can assure that 5G and the total radiation levels caused by RF-EMF (5G together with 2G, 3G, 4G, and WIFI) will not be harmful for EU-citizens, especially infants, children and pregnant women, as well as the environment.
- 2) To recommend that all EU countries, especially their radiation safety agencies, follow **Resolution 1815 and inform citizens, including, teachers and physicians, about health risks from RF-EMF radiation, how and why** to avoid wireless communication, particularly in/near e.g., daycare centers, schools, homes, workplaces, hospitals and elderly care.
- 3) To appoint immediately, without industry influence, an EU task force of independent, truly impartial EMF-and-health scientists with no conflicts of interest¹ to re-evaluate the health risks and:
 - a) To decide about **new, safe "maximum total exposure standards"** for all wireless communication within EU.
 - b) To study the total and cumulative exposure affecting EU-citizens.
 - c) To create rules that will be prescribed/enforced within the EU about how to avoid exposure exceeding new EU "maximum total exposure standards" concerning all kinds of EMFs in order to protect citizens, especially infants, children and pregnant women.
- 4) To prevent the wireless/telecom industry through its lobbying organizations from persuading EU officials to make decisions about further propagation of RF radiation including 5G in Europe.
- 5) To favor and implement wired digital telecommunication instead of wireless.

We expect an answer from you no later than **October 31, 2017** to the two first mentioned signatories about what measures you will take to protect the EU-inhabitants against RF-EMF and especially 5G radiation. This appeal and your response will be publicly available.

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WE will add signatories to the following list through the end of 2017. The updated list of signatories and the appeal can be found later [HERE](#).

¹ Avoid similar mistakes as when the Commission (2008/721/EC) appointed industry supportive members for SCENIHR, who submitted to EU a misleading SCENIHR report on health risks, [giving telecom industry a clean bill to irradiate](#) EU-citizens. The report is now quoted by radiation safety agencies in EU.

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Note: The endorsements are personal and not necessarily supported by the affiliated universities or organizations.

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Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range

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Recent studies of the minute morphology of the skin by optical coherence tomography showed that the sweat ducts in human skin are helically shaped tubes, filled with a conductive aqueous solution. A computer simulation study of these structures in millimeter and submillimeter wave bands show that the human skin functions as an array of low- Q helical antennas. Experimental evidence is presented that the spectral response in the sub-Terahertz region is governed by the level of activity of the perspiration system. It is also correlated to physiological stress as manifested by the pulse rate and the systolic blood pressure.

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Experimental evidence indicating that the electromagnetic properties of the human skin in the sub-Terahertz frequencies are governed by its morphology is henceforth presented.

The human skin is the largest organ of the body, designed as the primary interface, utilizing numerous of functions and interactions between us and our environment. The complexity of the multilayered skin morphology provides an extremely broad range of features of sensors that utilize a number of physical phenomena. One of these skin features is the perspiration system that traditionally is mainly considered for body thermoregulation [1]. Its main components are sweat glands embedded into the dermis and connecting through the epidermis with the pores on the surface of the stratum corneum by ducts, filled with a conductive aqueous solution. The general illustration of sweat glands presents a convoluted arrangement for the sweat gland and a more or less straight tube for the duct [1,2]. In recent investigations of the subcutaneous morphology of the human skin by optical coherent tomography [3,4], it was found that the sweat duct is in fact a remarkably arranged helical conductive tube (Fig. 1). This, together with the fact that the dielectric permittivity of the dermis is higher than that of the epidermis, brings forward the supposition that as electromagnetic entities, the sweat ducts could be regarded as low- Q helical antennas. Inherent to this supposition is the requirement that the duct possesses an electrical conductance mechanism that is effective at the extremely high frequency (EHF) range. Even though the ducts are filled with conducting electrolytes, the ions mobility rates associated with sweat are slow compared to the characteristic frequencies under consideration. A mechanism that qualifies for such a requirement is fast proton hopping through distributed H -bond networks along the duct surface. It is well established that these networks exist in biological structures [5] and it was found that the characteristic time for such proton transport is about 10^{-13} sec [6].

When the potential drop caused by the difference in pH values between the skin surface and the dermis is taken into consideration [2], such hopping can account for the ac conductivity that is necessary for the sweat ducts to yield an electromagnetic response in the EHF range. Moreover, it is known that the human skin contains approximately 2 to 5×10^6 eccrine sweat glands distributed over most of the body, with higher density in several areas such as on the palms of the hand, the forehead, and on the soles of the feet [7,8]. As each gland is connected to the skin surface by a helical sweat duct, the skin organ in its entirety can be regarded as an array of helical antennas that operate in the EHF range. It has been ascertained that the level of sweating has a dominant effect on the conductance parameters of the various components of the skin tissue. As pointed out above, these parameters strongly affect the spectral response of the skin organ. Hence, it is predicted that the physiological and psychological parameters that are known to be expressed in the activity of the perspiration system [9]

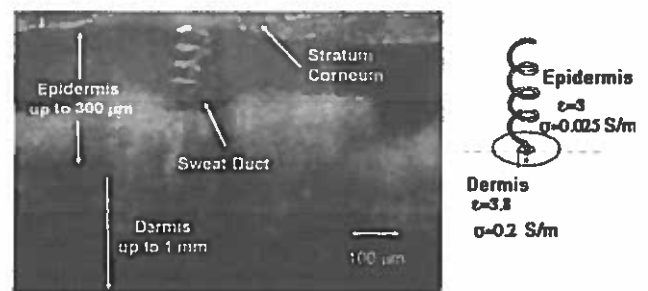


FIG. 1. 3D optical coherence tomography image (reproduced with permission from ISIS GmbH) of a single human eccrine sweat gland embedded in the human skin and a schematic presentation of the duct as a helical antenna [20] embedded in the skin, where the dermis-epidermis interface acts as a dielectric reflector. The respective permittivities of the skin layers are marked. They were estimated for the specific frequency range based on the water content of the layers [10].

will also be manifested in the spectral response of the skin in the EHF frequencies.

To test the validity of this prediction we conducted a series of *in vivo* measurements of the skin reflection coefficient of the hand palm in several subjects. The first set of measurements was done using a vector network analyzer (VNA) in the spectral range of 75 GHz to 110 GHz (*W* band). In order to avoid parasitic reflections and diffraction effects the first set of measurements was done in a system that was configured for near field measurements. The initial real system measurement was done when the subject was fully rested. The subsequent measurement was done immediately after a period of 20 min of intense jogging, and was followed by a series of measurements every 1 min

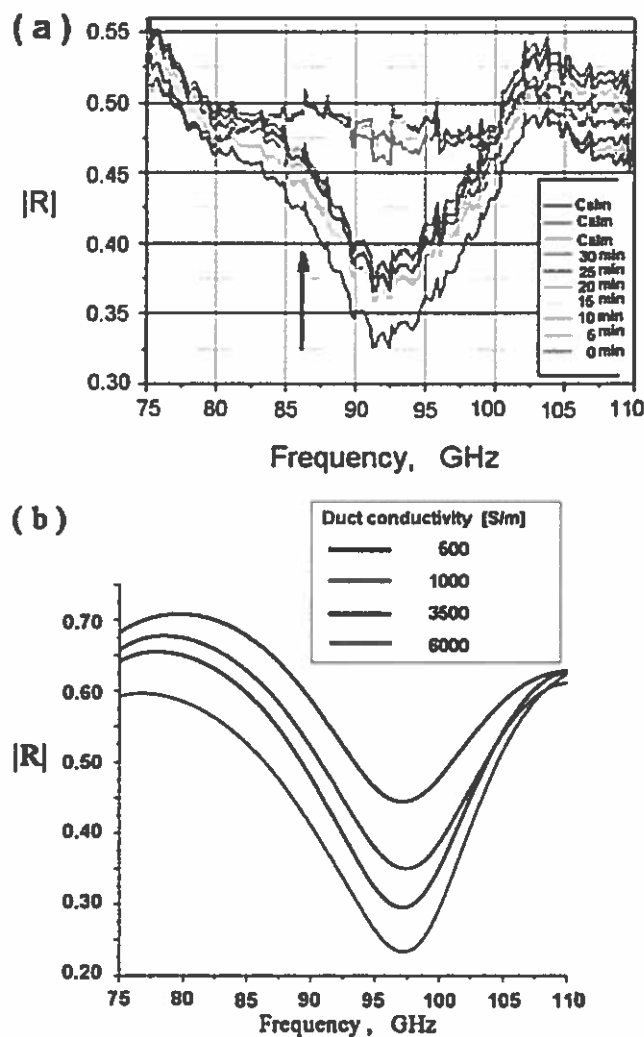


FIG. 2 (color). (a) Measurements of the modulus of the reflection coefficient R of the human palm in the frequency region 75 to 110 GHz. The subject was measured using VNA HP 8510C in the near field in a calm state and then during 30 min relaxation after intense physical activity. The arrow on the graph indicates the direction of the time line and shows how the signal returns to the calm state with relaxation; (b) The simulation of the reflection coefficient from 8 coils embedded in an idealized skin.

as the subject relaxed. A typical series of measurements for one subject is presented in Fig. 2(a). As can be seen there is a pronounced difference between the reflectance spectra that were measured in the calm state and immediately after a period of physical activity. In the subsequent measurements, as the subject relaxed back to the calm state, the spectral response of the coefficient also relaxed back towards its initial curve. These results were compared to a computational study of the propagation of an electromagnetic beam in an idealized section of the skin containing eight helical sweat ducts. The sweat ducts were modeled as conducting coils of 2 to 4 turns with diameters 60 to 80 μm and heights 300 to 350 μm (see Figs. 3 and 4). The skin layer was modeled as three strata representing the stratum corneum, the epidermis, and the dermis. The water concentration was set to be 10%–15% in the stratum corneum, 45%–55% in the epidermis, and 70%–80% in the dermis [10]. The stability of the hydrogen network inside the coil and hence the resultant level of proton conductivity is expected to exhibit a direct dependence on the sweat rate. Hence, the conductivity of the coil can be used as the parameter that quantifies the level of relaxation following intense physical activity [11,12], i.e., it is expected that the conductivity of the coil will follow the same time dependence as the decaying sweat flow in the ducts. The computed spectra of the reflectance coefficient for different levels of duct conductivity are shown in Fig. 2(b). It can be seen that the spectral response of the reflection coefficient is very similar to the experimental results.

The second set of measurements was done in a system that was configured for distance measurements. The palm was held steady by a stand that was placed 22 cm from the horn antenna at the input of the VNA, and a dielectric lens was used to collate the beam. Sets of identical measurements were taken of an ensemble of 13 subjects differing in gender, age and ethnic origin. Each set included a measurement of the skin reflectance, and concurrent recordings of the pulse rate, the systolic blood pressure, and the skin temperature.

The subjects performed 20 min of jogging after which a sequence of 30 sets of measurements were taken at 1 min intervals.

A typical sequence of sets of measurements is presented in Fig. 5(a). The skin reflectance is presented in terms of its

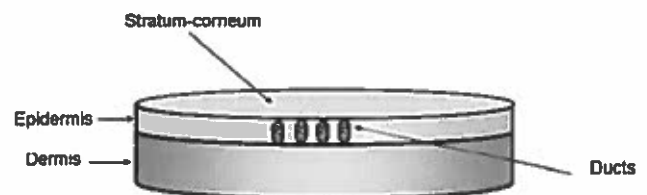


FIG. 3. The model used for 3D Electromagnetic simulations. The disk represents a portion of skin consisting of 3 separate layers and an array of 8 sweat ducts being subjected to a signal from the wave guide.

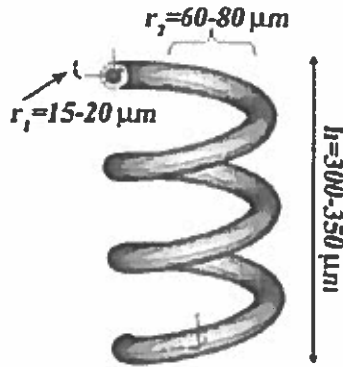


FIG. 4. The idealized sweat duct used in the simulation software "CST microwave studio" with the relevant dimensions. The sweat duct coil was modeled as a helical pipe filled with electrolyte. It is permanently full of sweat and so there exists a hydrogen bond network along the surface. Fast Proton hopping in H -bond network has been measured at 10^{-13} [6]. The difference in pH between the skin surface and the dermis results in a concentration gradient $\Delta[H^+] = 3 \times 10^{-6}$ mole/l and subsequent potential drop. This is the possible cause of fast currents in the coil. Proton conductivity in bulk water in biological structures has been measured at 100–1000 S/m [21]. Therefore in the simulation duct conductivity was set accordingly high, $\sigma = 500$ –20 000 S/m [see Fig. 2(b)].

frequency averaged relative signal intensity given by

$$\langle W_{rel} \rangle = \frac{1}{f_2 - f_1} \int_{f_1}^{f_2} \frac{|U_{subject}|^2}{|U_{reference}|^2} df, \quad (1)$$

where $U_{subject}(f)$ is the reflected signal from the subject after physical activity, $U_{reference}(f)$ is the reflected signal measured from the subject while sitting calmly before physical activity, $f_1 = 75$ GHz, and $f_2 = 110$ GHz. It can be seen that after the physical activity an exponential-like relaxation is observed, which is correlated to physiological stress as evidenced by parallel relaxations in pulse rate and systolic blood pressure. The results are summarized in Fig. 5(b) in which the normalized ensemble average of W_{rel} , denoted as $\langle W_{rel} \rangle$, for the 30 measurement points are presented vs the respective ensemble average of the systolic blood pressure. A strong correlation, defined by the coefficient r is clearly manifested with $r = 0.984$

$$r = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^N (x_i - \bar{x})^2 \sum_{i=1}^N (y_i - \bar{y})^2}}. \quad (2)$$

To rule out the possibility that the observed phenomena could be due to the water content in the skin and underlying tissues, an additional set of measurements using a pressure cuff were performed. This allowed control of the blood flow during the measurement without activating the sweat gland system. As the cuff pressure is increased (0–100 mm Hg), it reduces the capillary blood flow [13] resulting in an increase of the total amount of blood in the skin and underlying tissue [14].

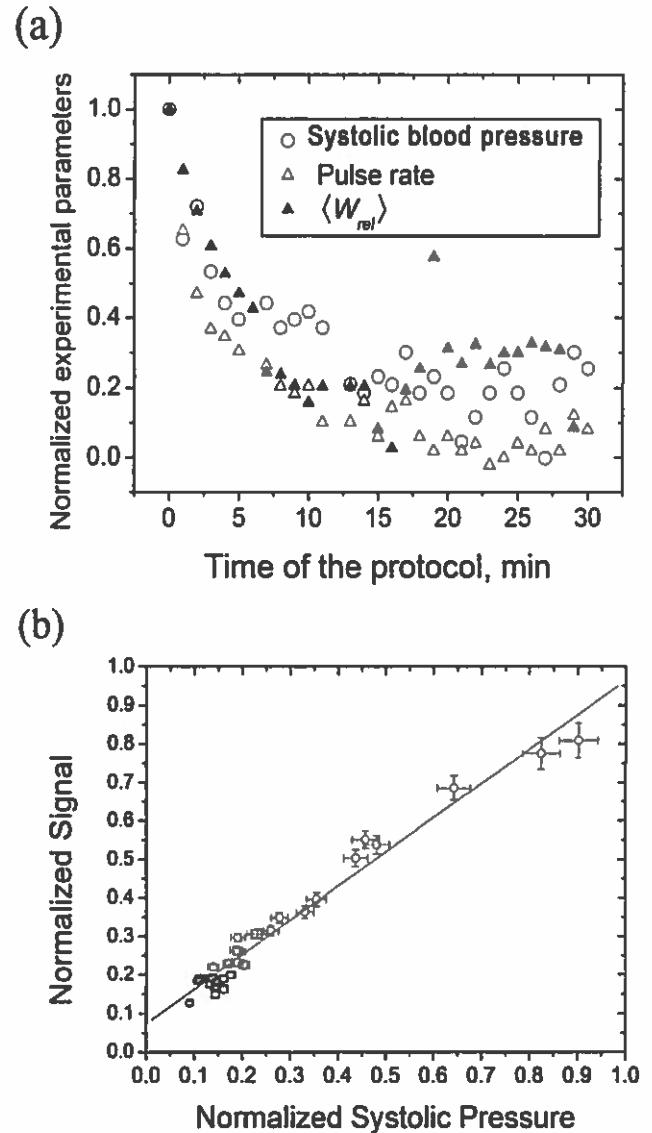


FIG. 5 (color). (a) The frequency averaged relative signal intensity $\langle W_{rel} \rangle$ recorded from reflection coefficient measurements in the frequency band 75–110 GHz of the palm of a subject at rest following 20 min of intense physical activity. To avoid reflection from surface water the hand was kept dry; (b) the correlation graph between systolic blood pressure and $\langle W_{rel} \rangle$, obtained from the average of 13 subjects measured as they relaxed for a period of 30 min after intensive physical activity. The intensities and blood pressures were normalized over their amplitudes to allow averaging and the correlation coefficient was calculated from linear regression. The value $r = 0.984$, close to unity, demonstrates a strong correlation between them. Essentially they exhibit similar temporal behavior. The correlation of $\langle W_{rel} \rangle$ with the pulse rate is $r = 0.85$.

Measurements of the normalized average reflectance show no noticeable dependence on the capillary blood flow or change in volume fraction in this tissue compartment.

In order to test the effect of active or inactive sweat glands on the reflection coefficient a creme containing a

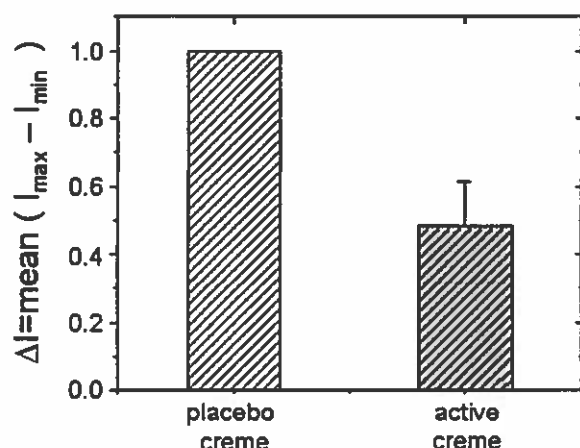


FIG. 6. The effect of temporally deactivated sweat glands on the relative signal intensity is illustrated by the lowered amplitude, using the synthetic tripeptide, applied to the skin surface 120 min before measurement. The amplitudes are averaged over 8 subjects and shown relative to the amplitude recorded when using a placebo creme.

snake venomlike synthetic tripeptide acting as an antagonist of the postsynaptic muscular nicotinic acetylcholine membrane's receptor (mnAChR), was applied to the test area [15]. The measurements of the reflection coefficient were repeated again after exercise. The same subjects were then treated with a placebo creme, based on the same matrix but not containing the synthetic tripeptide [16]. This was done in order to account for any hydrating effects of the creme itself. The results demonstrated a significantly lowered signal intensity when the active component was used, indicating the importance of neurally active/regulated sweat glands in the received signal. The results are illustrated in Fig. 6.

In summary it is claimed that individual sweat ducts are low- Q helical antennas and that their presence in the skin means that the skin can be regarded as a 2D antenna array in the sub-terahertz region. The spectral response is sensitive to the activity of the sweat system. These claims were substantiated experimentally where it was shown that the spectral response of the EM reflectance of the skin is indeed correlated with the activity level of the perspiration system and follows the same temporal behavior as other physiological parameters, such as the pulse rate and the systolic blood pressure. This phenomenon can be used as the basis for a generic remote sensing technique for providing a spatial map of the sweat gland activity of the examined subjects. As the mental state and sweat gland activity are correlated [17–19] it has the potential to become a method for providing by remote sensing informa-

tion regarding some physiological parameters and the mental state of the patients.

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